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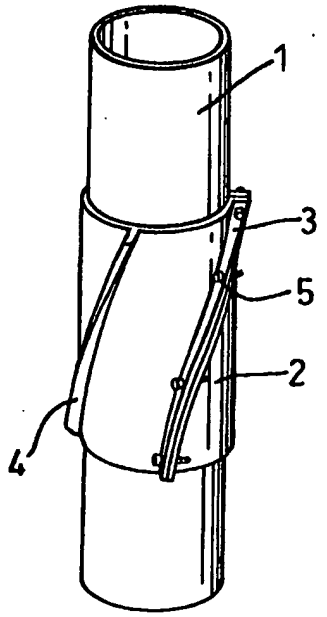
(54) Title: IMPROVEMENTS RELATING TO PILE WRAPPERS

(57) Abstract

A pile wrapper comprises a flexible sheet (2) of parallelogram form with stiff but not completely rigid members (3) along a pair of opposite edges proud of the side of the sheet to be exposed. This side also has flexible ribs or vanes (4) parallel to those members. When wrapped around a pile (1) the members (3) are squeezed and fastened together, forcing those members into a helical configuration, similar to that adopted by the ribs or vanes (4). Water flowing past the pile is diverted towards the longitudinal direction of the pile, reducing the tendency to vortex induced vibration.



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"Improvements relating to Pile Wrappers"

This invention relates to pile wrappers. It is a development of that described in our Patent EP(UK)0295254.

Pile wrappers are retro-fitted to protect piles against corrosive action of sea water and marine growth. In that earlier Patent, the wrapper is a flexible sheet with substantially rigid members along substantially the entire length of the opposed edges which are adjacent when the wrapper is positioned around the pile. These members are then squeezed together, creating hoop stresses in the outer skin of the wrapper, and fastened. The outer skin is of water impermeable flexible material, such as reinforced plastics or rubber, and an inner layer of liquid permeable material such as felted or porous plastics material can be impregnated with a water resistant sealant having corrosion inhibiting and/or biocidal components. This will generally be in the form of a thixotropic gel which will 'wet' the wrapped surface and be forced into every interstice, scratch or pitting.

This has proved very successful and such wrappers removed after several years have revealed near-perfectly preserved pile surfaces. In certain circumstances, especially in a strong current, deep water application, vortex induced vibration (known as v.i.v.) occurs. This is a phenomenon produced by the action of a liquid or gas passing over a structure at high velocity. At low velocity, a liquid such as seawater will streamline round a cylindrical member such as a pile and generally the boundary layer around the

member will be unaffected. However, as the velocity increases, the dividing of the streamlines causes the boundary layer to separate from the surface of the member, with eddies or vortices forming just downstream. The greater the velocity, the more pronounced this effect, to the point where the size and unsteadiness of the eddies, and the general turbulence, causes mechanical excitation of the member or v.i.v. It can lead to premature fatigue failure and loss of structural integrity.

It is the aim of this invention to counteract this v.i.v.

According to the present invention there is provided a pile wrapper comprising a flexible sheet with stiff members along opposite edges proud of the side of the sheet to be exposed and fastenable together, when the wrapper encircles a pile, to hold the sheet tensioned, the exposed side of the sheet being provided with ribs or vanes which, when the wrapper is fixed around a pile, assume generally helical configurations.

The effect of these ribs or vanes will be to divert a substantial amount of the energy of the water flowing past vertically, in a manner such that its dissipation has considerably less tendency to generate v.i.v.

The wrapper may initially be parallelogram-shaped with the edge members that are brought together parallel to the ribs or vanes. Then those members can, when fastened together and effectively unified, serve as another generally helical rib or vane.

The ribs or vanes may be equi-spaced. However, experiments may show that where a pile to be wrapped stands in water with a current predominantly in one direction (or that direction and its opposite) it may be better to have ribs or vanes with differentiated spacing.

The preferred angle of the helix and the optimum number of ribs or vanes has yet to be determined, but probably 55° - 60° to any cross-section of the pile will give a satisfactory performance, while just three ribs or vanes (including the one formed by the join) could be quite sufficient.

As with EP(UK) 0295254, the sheet will normally be a composite of an outer water-impermeable material and an inner layer of liquid permeable material impregnated with a water resistant gel.

The ribs or vanes may be of the same material as the outer skin, but preferably they will be somewhat softer and capable of flexing to assume the contour of the pile surface. Such materials will dissipate some of the energy in the water flowing past. With rubber as the basic material, they will preferably be vulcanised onto the outer skin.

For a better understanding of the invention, one embodiment will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a diagram of water flow around a pile,

Figure 2 is an elevation of a pile wrapper being offered up to a pile,

Figure 3 is a perspective view of the wrapper almost

encircling the pile,

Figure 4 is a perspective view of the wrapper secured around the pile,

Figure 5 is an elevation of several wrappers around a pile, but not properly positioned in order to show overlap arrangements, and

Figure 6 is an elevation similar to Figure 5 but with the wrappers butted together.

In Figure 1 a cylindrical pile 1 in a stream of water indicated by the broken lines causes eddies E to form on the downstream side, and these can lead to v.i.v. as explained.

At least one wrapper 2 is wrapped around the pile 1 and secured to counteract this. It is of parallelogram form, constructed (apart from shape) substantially as explained in EP (UK) 0295254. Two parallel edges are horizontal (or perpendicular to the axis of the pile if that is inclined) while the other two parallel edges are at an angle α (in this example 57.25°) to the first edges. Along these inclined edges are reinforced neoprene strakes 3, projecting away from the pile and bonded to a neoprene jacket forming the outer skin of the wrapper. The strakes 3 must not be rigid, as could be the equivalent members in EP (UK) 0295254, but they will have to be quite stiff. The outer skin has, in addition, two outwardly projecting neoprene vanes or ribs 4 parallel to the strakes 3. These may be generally equi-spaced from the strakes 3 and each other, or they may be unevenly spaced as in Figure 2, where their mutual spacing is larger than their spacing from the strakes

3.

The wrapper 2 is folded around the pile 1 as shown in Figure 3, and secured by stainless steel nuts and bolts 5 through the strakes 3 when those have been squeezed together. The wrapper then appears as in Figure 4. The strakes 3 are initially straight, but their lack of complete rigidity allows them, as a result of the squeezing together action, to bend and to adopt a part helical configuration following the shape of the pile 1. The vanes or ribs 4 also deform to follow parallel helical paths: indeed they may be more flexible than the outer skin of the jacket itself.

It may be necessary to fit more than one wrapper to the pile. At the meeting of each adjacent pair of wrappers a gel-impregnated cummerbund 6 is wrapped around the pile, one end having a substantial overlap with the other.

The wrappers are placed so that they abut substantially at the middle of a common cummerbund, which is sandwiched firmly between the wrappers and the pile.

As seen in Figure 6, the wrappers are set so that the strakes and vanes of one merge smoothly into those of the next, forming continuous helices.

Although described mainly in terms of a vertical pile, it will be understood that the wrapper is equally applicable to angled or even horizontal pile-like members, such as pipelines. The preceding description and the claims should be construed accordingly.

CLAIMS

1. A pile wrapper comprising a flexible sheet with stiff members along opposite edges proud of the side of the sheet to be exposed and fastenable together, when the wrapper encircles a pile, to hold the sheet tensioned, the exposed side of the sheet being provided with ribs or vanes which, when the wrapper is fixed around a pile, assume generally helical configurations.

2. A pile wrapper as claimed in Claim 1, wherein the edge members are parallel to the ribs or vanes and, when fastened together, form another generally helical rib or vane.

3. A pile wrapper as claimed in Claim 1 or 2, wherein the ribs or vanes are equi-spaced.

4. A pile wrapper as claimed in Claim 1 or 2, wherein the ribs or vanes are differentially spaced.

5. A pile wrapper as claimed in any preceding Claim, wherein the angle of the ribs or vanes to any cross-section of the pile is in the range 55° - 60°.

6. A pile wrapper as claimed in any preceding Claim, wherein the sheet is a composite of an outer water-impermeable material and an inner layer of liquid permeable material impregnated with a water resistant gel.

7. A pile wrapper as claimed in Claim 6, wherein the ribs or vanes are of the same material as the outer skin.

8. A pile wrapper as claimed in Claim 6, wherein the ribs or vanes are softer and more flexible than the outer skin.

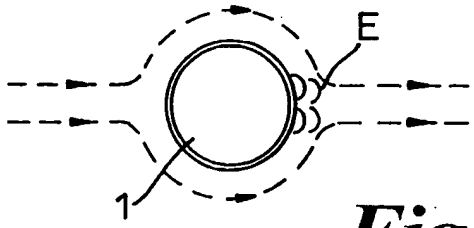

Fig. 1

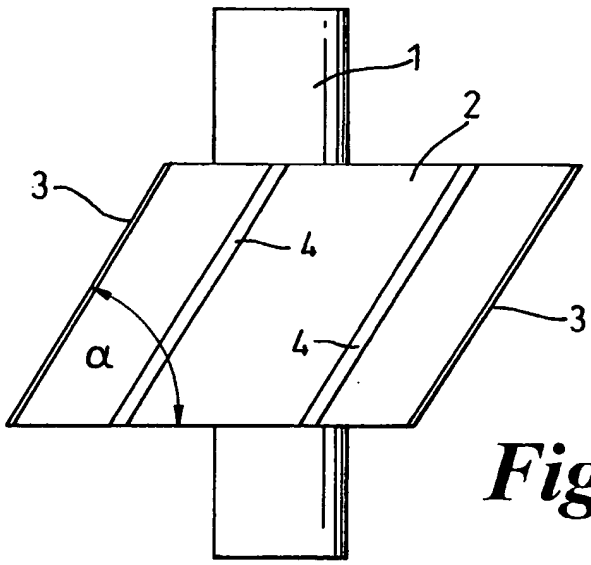

Fig. 2

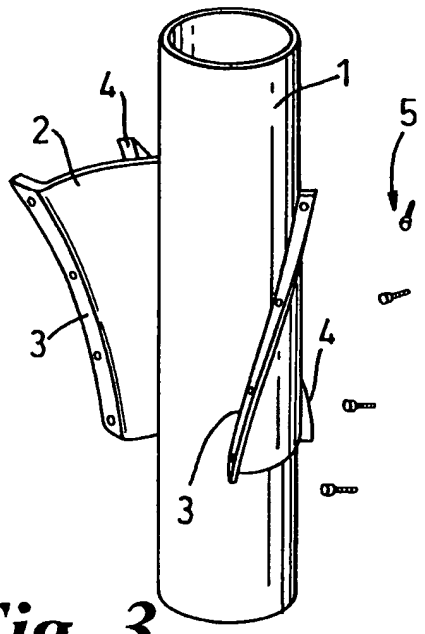

Fig 3

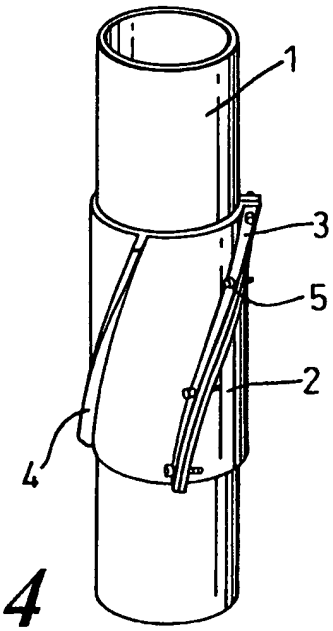

Fig 4

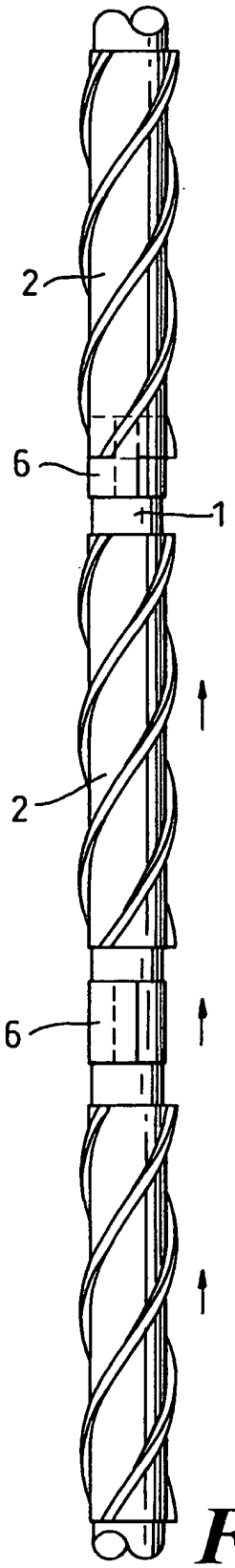

Fig. 5

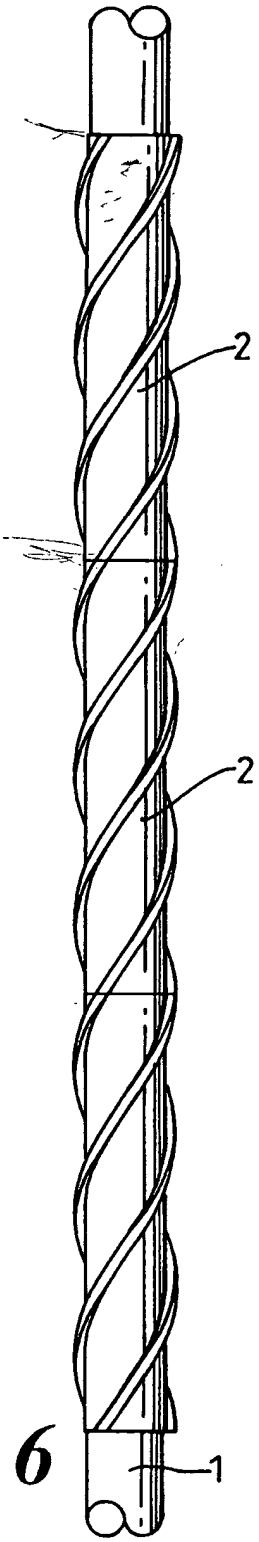

Fig. 6

INTERNATIONAL SEARCH REPORT

Int. .donal Application No
PCT/GB 97/02819

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 E02D31/06 E02D5/60

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 E02D F16L E02B E21B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 616 940 A (MITSUI SHIPBUILDING ENG) 28 September 1994 see page 5, line 5 - page 12, line 51; figures 1-24	1-4,7
A	WO 80 00262 A (MOAT LTD ;ALDRIDGE T (GB)) 21 February 1980 see page 3, line 18 - page 6, line 31; figures 1-19	1
A	WO 93 21392 A (STRANGE ANTHONY EDWARD JOHN) 28 October 1993 see page 7, line 2 - page 10, line 16; figures 1-4	1

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Information on patent family members

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